

DARWIN'S CONTRIBUTION TO PSYCHOLOGY.*

EDWARD L. THORNDIKE.

Psychology, as you all know, means the science of mental, as opposed to physical, facts—the study of thoughts and feelings, as opposed to physical objects. But the science of mental facts may mean to different individuals and at different times very different things; and to understand Darwin's contribution to it we must for a moment consider some of them.

To most of the writers on psychology of the first half of Darwin's century, it meant naming, describing, and classifying our states of mind and our so-called mental powers. For instance, the most important writer of this sort of psychology in Darwin's youth was James Mill. His son held the same position during Darwin's maturity. I quote almost at random from a book written by the former and edited by the latter, *The Analysis of the Phenomena of the Human Mind*.

"When we have an idea, the having the idea, the being conscious of the idea, knowing the idea, observing the idea, are only different names for the same thing. They mean the being conscious in a particular way. But the being conscious is to take notice of the consciousness. To be conscious and not to take notice, is the same as to be conscious, and not conscious. The notice is the consciousness and the consciousness is the notice."

Darwin nowhere makes mention of this book, and, so far as we know, never read it. Had he read it, and been

* Address delivered June 21, 1909, during the Summer Session of the University of California.

asked about, say, this passage, he would probably have said modestly that he was not at all sure that he understood what it was all about.

About a year after the publication of the *Origin of Species* there appeared the *Psycho-Physics* by Fechner, a book in which experiment and elaborate measurement were put to service in support of psychological theories. The theories in this case concerned the relation of mental states to the physical events which caused them. The book was one of the chief beginnings of present experimental psychology. It, too, Darwin nowhere mentions and almost certainly never read. In fact Darwin never felt any great interest in the inner life of the mind—in thoughts and feelings studied for their own sake. And he would have doubted his competence to observe or argue about them.

At the time of the publication of the *Origin*, too, Ibsen was doing his first successful work and training himself for those later plays, each of which, by the insight of the artist, is a masterpiece in the psychology of human motive and passion. George Meredith was already writing his wonderful psychological novels. But such psychology as Ibsen's or George Meredith's would have been, I will not say beyond Darwin, but entirely apart from him. He was too simple and direct to enjoy and, possibly, fully to understand subtle analyses of the complex passions, conventionalities, and conflicts in human nature.

But psychology, at least to-day, means more than such reflections as Mill's, such measurements and speculations as Fechner's, and such insights as Ibsen's or Meredith's. It means the study of intellects and characters in all their relations to the bodies which possess them. Human psychology shares with physiology, anthropology, and sociology the study of all human nature and activity. Psychology in general shares with zoology the study of all animal nature and activity. Now in the activities and the behavior of man, as of any other animal, Darwin was interested. He was preeminently a naturalist. Only when the

mind played a part in the general economy of life,—only when it could be studied from the outside by careful and impartial observation of its effects, did he feel special interest or show special capacity in studying it. It was to psychology as the science of human and animal behavior that he contributed. Just what his contribution was is our question for this hour.

He made four important direct contributions to psychology. First of all, he showed in the *Origin of Species* and in the *Descent of Man* that the instincts and the moral and aesthetic capacities of man are subject to variation and natural selection. Again and again he gives concrete evidence that the mind, like the body—the behavior of an animal, like its structure—is the product of a long growth, not a sudden creation. Intellect and character have a natural, not a miraculous, history. The mind is to be derived as well as described.

It is somewhat amusing to note that the implication that our intellect and character are descendants from those of non-human animals did not provoke so much resentment as the implication that our bodies came from their bodies. To many eminent divines the idea that their bodies should be related, even at a distance of a thousand centuries, across a thousand cousinships, to the bodies of apes was so repugnant that they took its falsity for granted without the slightest investigation. Yet they showed far less irritation at the hypothesis that their minds and manners were bound to the apes by the same link. Perhaps this notion was so utterly preposterous that they did not even understand it.

Darwin's second direct contribution to psychology was made in connection with his doctrine (of sexual selection) that the attractiveness of certain qualities in one sex to the other sex selected those qualities for survival regardless of any further utility. It consisted in a fund of data regarding the attractions and aversions manifested by animals, including man.

The fact of sexual selection is probably subordinate to

natural selection as one minor outcome of it—not coördinate and independent as Darwin seems to have thought. The attractions and aversions which he inferred from the structure and movements of animals probably do not in all cases exist. And the semi-aesthetic feelings ascribed to the animals by him are almost entirely not what he supposed them to be, or at least not what he led others to think he supposed them to be. But after a generous allowance for these imperfections, there remains a body of valuable observations of animal behavior and a stimulus to the study of a very important biological and psychological problem.

Darwin's third direct contribution to psychology was an account of the bodily expression of the emotions, which is still, after nearly forty years, the most distinguished study of this topic. I cannot in a brief description or by quotations give an adequate idea of the wealth of detailed observations and the carefulness in theorizing which characterize this book. Its most striking doctrine is that certain acts, which were in our ancestors ordinary acts aimed to produce an effect on something or somebody, have left, as slight relics of themselves, acts of emotional expression. Thus, the uncovering of the teeth, especially of the canine teeth, preparatory to biting an antagonist has dwindled into the snarl of anger and the sneer of scorn. But Darwin did not overstrain evolution as an explanation of the ways in which emotions and bodily conditions are related each to the other and to the cause of both. If you will read his accounts of weeping, blushing, shaking the head for negation, and the muscular turmoil of rage, you will be convinced of his breadth of view and fine sense of fact throughout. For instance, he gives full attention to the law of habit and to what is now called the diffusion of the motor impulse.

Darwin's fourth contribution was his study of the mental development in infancy of one of his sons. This, the first of the psychological biographies of babies, is also one of the best. It is characteristic of Darwin's modesty that he did not announce that he had used a new method of research

or advertise the importance of child psychology. On the contrary he did not intend to publish this study at all and did so only years later to meet a need aroused by Taine's similar study.

One special aim of this biography of a baby by its father was to ascertain the resemblances of the mental life of infancy to the mental life of the lower animals, an inquiry which has since been made the chief business of one whole school of psychologists, led by the American, G. Stanley Hall.

There is a type of prejudice which would readily make capital out of this fact—that a man of science experimented on his own child—and which would call attention with a sneer to the evolutionist seeing in his own child only likenesses to the lower animals. It is the direct object of this lecture to display the influence of Darwin's work, not the dignity, gentleness, and quiet heroism of his life; but I venture to read to you a letter written after the death of one of his children. It is perhaps too intimate for quotation on an occasion like this, but it is right and fitting that with Darwin, as with Lincoln, we should join to esteem of his work, honor and affection for the man.

"It was delightful and cheerful to behold her. Her dear face now rises before me as she used sometimes to come running down-stairs with a stolen pinch of snuff for me, her whole form radiant with the pleasure of giving pleasure. Besides her joyousness, she was in her manners remarkably cordial, frank, open, straightforward, natural, and without any shade of reserve. Her whole mind was pure and transparent. One felt one knew her thoroughly and could trust her. . . . In the last short illness her conduct was in simple angelic. She never once complained; never became fretful; was ever considerate of others, and was thankful in the most gentle, pathetic manner for everything done for her. When so exhausted that she could hardly speak she praised everything that was given her, and said some tea was "beautifully good." When I gave her some water, she said "I quite thank you," and these, I believe, were the last precious words addressed by her dear lips to me.

"We have lost the joy of our household and the solace of our old age. She must have known how we loved her. Oh, that she could now know how deeply, how tenderly, we do still and shall ever love her dear joyous face! Blessings on her!"

It would well repay us to return to a more adequate study of Darwin's psychological work, but the rest of the hour must be reserved for his still more important indirect contribution through his more strictly biological work.

First of all, of course, Darwin gave psychology the evolutionary point of view. Psychology had studied the human mind by itself alone and had taught that our minds were all made after one pattern mind, which worked as it did for no intelligible reason, but just because it did. Darwin showed psychologists that the mind not only is, but has grown, that it has a history as well as a character, that this history is one of hundreds of thousands of years, and that the mind's present can be fully understood only in the light of its total past.

Psychology has by no means fully mastered this lesson. Human learning is still too often described with total neglect of animal learning. But each decade since the *Origin of Species* appeared has shown a well marked increase in comparative and genetic psychology. Of our own countrymen, for instance, William James, Stanley Hall, and John Dewey have consistently worked at psychology on a genetic basis. Psychology has also been careless in applying this lesson. The ostensible followers of Darwin have sometimes shown far too little of his industry in mastering facts and of his caution in making inferences from them. The kind of thinking that considers the pleasure humans take in swimming fully explained as a relic from the minds of our ancestors who were fish, or that accounts for human co-operation in industry by reference to ants, bees, and wasps, may take the name, but has not the spirit, nor, in reality, the method of Darwin. But, side by side with such extravagant speculations and unnatural history, careful observations and experiments have been made with reference to animal learning, to the mental powers of primitive man, and to the mental evolution of the human species.

Only those of expert acquaintance with the recent history of psychology would appreciate a list of the psychol-

ogists who have thus been Darwin's followers, or a review of the investigations which they have made; but you will all perhaps be interested to know the present status of the doctrine of mental evolution,—the present belief concerning the genealogy of human intellect and character.

I must warn you that we shall be dealing with the battle of investigation at its very outposts, hearing the latest returns, but not knowing how far they will be finally confirmed; and that very many of my statements may be amended by later and better work. But I can only report what, with present knowledge, seems to me the course of development of the human intellect. Of the development of human character, I cannot, for lack of time, speak at all. And for the same reason, I must begin our mental history, not at the very beginning, but half way in its course, with the fishes.

You know that starting from this point our bodily descent is roughly as follows: fishes begat amphibia; amphibia begat reptiles; reptiles begat mammals; some early mammals begat the primates; some early primates begat man.

The existing fishes have intellects of a sort, in the sense that they can learn,—can so change their natures as not to do the same thing in the same circumstances. The unfit object they first tried to eat, they later reject; the unfit place they first went to, they later avoid. The nature of their learning will be clear from a simple but typical instance.

If the common Fundulus of the New England coast is confined by a wire screen at one end of an aquarium upon which direct sunlight shines, it reacts to the situation by swimming toward the shaded end of the aquarium. "When it pokes its head against the screen, it changes direction, swims alongside the screen, and then again toward the shaded end. It will thus in the course of time swim at nearly every square inch of the screen. If now a small hole has been left in the screen, say in the upper right-hand corner, the fish will, in the course of such instinctive swimmings toward the

shade and changes of direction, swim through the hole and reach the shaded end, where it will remain in physiological peace. If the experiment is repeated again and again, say at intervals of twenty minutes, the fish will make, sooner and sooner, fewer and fewer of the useless darts at the screen, will make the appropriate movements of swimming to the right, rising up, and swimming through the hole. Whereas at the first trial it spent five or ten minutes in getting out, it will now spend less and less time. Eventually, after many trials, it will have eliminated all the futile movements,—will, when confined by the screen, swim to and through the hole directly in five or ten seconds.

The fish has learned to respond to that particular situation in an adaptive way. It has modified its behavior to suit the situation. Its learning consists in the stamping in or strengthening of the connection between that situation and the particular response of swimming to and through the hole, and the weakening and final elimination of the connections between that situation and the movements which resulted only in the perpetuation of the unsuitable situation. Sensitiveness to a situation, a variety of responses, the selection of the fit one and its association with the situation, are the four essentials of its learning. No "ideas" or "thinking" of the human sort are necessary to account for it.

Such learning by directly connecting certain responses with a situation and disconnecting certain others from it, was undoubtedly characteristic of the fishes of long ago who were our fore-fathers. They learned, but they learned without thinking about the situation or thinking beyond the situation. They learned very few things.

The amphibians and reptiles, which come next in the line of descent, show the same sort of intellect, the only known difference being that in general they can be sensitive to more kinds of situations, can make more kinds of responses, and can connect the latter with the former in more ways.

In the case of the mammals, other than the primates, special studies have been made of dogs, cats, rats, mice,

racoons, and guinea pigs, which agree in finding this same learning by the direct selection of one response for association with a situation as the main component of the animal's intelligence. With it there are, possibly, obscure traces of the life of ideas, of thoughts of things past and to come, of things bound to the actual present situation only by connections made in the animal itself. But the early mammals, who are in the direct line of descent to man, probably progressed beyond the reptiles only by being able to learn more and different habits, not by learning them in a more human way.

In the monkeys, which have been studied somewhat elaborately by four psychologists, the same learning without thought, the same responding to the situation of the moment without recalling the past or foreseeing the future, the same trial and success method, is the rule. The monkey in general does not call up ideas, select the idea that seems fit, and act upon it. He acts impulsively, not intellectually, doing not what he thinks of doing, but what he feels like doing. But he feels like doing an enormous number of things; and at times, when one of those things is notably successful, he drops his previous behavior and adopts the successful act so suddenly that he *seems* to have formed not a habit, but a notion.

It is safest to doubt that having ideas, thinking about things instead of poking, pulling, biting, clawing and chattering at them, plays a large role either in existing primates or in the early primates who came between the mammals in general and those mammals whom we would accept as brother-men. But there can be no doubt that in the number of kinds of situations to which they respond, in the number of responses they make, in the number of connections they can make between situation and response, and in the love of mental activity for its own sake, the primate group—the present monkeys, chimpanzees, gorillas and the ancestors of them and of us—are far in advance of other mammals and in a line that leads straight to the human mind.

For the demonstrable intellectual difference between the year old baby and the monkeys is not that he has many ideas while they have few or none. He, too, has few or none. It is that he responds to more things and in more ways. He differs from the monkey as the monkey differs from the dog and as the dog differs from the fish.

The arousal of the human yearling by all sorts of sights and sounds, and his varied, incessant manipulations of all sorts of objects, seem a random, futile play. They do not seem to preserve him or the species. But it is this behavior, which we significantly call "monkeying with" things, that produces ideas. By responding to one thing in so many contexts and with so many acts, the little child comes to respond to it by no act at all, but by thinking it, having an idea of it. By extending the animal learning far enough, it of itself produces ideas, and ideas produce all the rest.

"When once the mind begins to function by having free ideas, all the phenomena of reasoning soon appear. The adult seems to differ enormously in intellect from the year-old baby. And in practical efficiency he does. But the psychological factors of an adult intellect are all observable in the average child of three. Roughly speaking, between his first and third birthdays a child becomes intellectually a full human being.

How slowly or how abruptly the changes came from early ancestors not intellectually above the present primates to our nearer ancestors possessing, like two-year-old children, free ideas of at least the common objects around them and their own common bodily acts, no one has attempted to estimate. It was a radical change in its consequences; but psychologically it would require only an extension of instincts and capacities already present in the primates. It could well have come, according to pure Darwinian principles, from small variations repeatedly selected. Thus in mind, as in body, man is a part of nature. His intellect is no new creation, but a simple, though extended variation from the general animal type as found in our nearest

physical relatives, the primates. Among the minds of animals that of man is chief, but also kinsman; ruler, but also brother.

The second great influence of Darwinism upon psychology was its stimulus to the study of the concrete particulars of intellect and character in individual men. You will remember that the voyage on the Beagle aroused in Darwin a permanent interest in the variations within species and in the gradations of species one into another. You will also remember that during most of his life thereafter he studied the variations of animals and plants from the type of the species, especially under the varying conditions supplied by domestication. His work turned the emphasis from the type to the variations from it. Biologists could no longer think of the animal and plant kingdom as a collection of replicas, occasionally imperfect or defaced, of originals made in some supernatural mint. Just as there is continuity, gradation, change little by little, as we pass backward to more and more remote ancestors, so within each species and between many species there is continuity, gradation, change little by little, as we pass sideways to more and more distant cousins. Psychology adopted somewhat reluctantly the new point of view. It used to speak in terms of the mind,—a pattern mind, possessed by all men. But now it studies "minds" rather than "the mind," and makes the differences which distinguish human individuals as significant as the likenesses which mark us as members of one species, and does not doubt that our common humanity goes with a very wide range of variation. Moreover, these intellectual and moral variations among men show as a rule continuity, gradation, change little by little.

Language encouraged us to think of men as grouped into clean-cut classes, good and bad, intelligent and stupid, quick and slow, and the like, and the pre-Darwinian psychology, in cases where it did get away from the doctrine of a single pattern mind, usually jumped to the equally false popular view of two or three or more patterns still distinct,

with gaps between. What psychology would not do was to think of intellectual and moral traits along continuous scales, as physical science thinks of length, temperature, weight, or density. But this is just what it must do to get insight into or control over the facts. And this it is now doing as a result partly of the general emphasis on quantitative methods in all sciences and partly of the special emphasis on variability and continuity in living things due to the work of Darwin.

The last line of influence from Darwin's work that I shall try to describe is the least definite, but perhaps the most important of all,—his influence in making psychology a natural science—in depriving teleological or supernatural causes from their last remnant of power in the minds of scientific men.

Primitive thinking explains events of every sort by supposing that someone wishes the event to take place. The wind blows because Poseidon wishes a storm. It thunders because Zeus wishes to show his wrath. The crop is good because Demeter so decides. Primitive thinking tries to control events by wheedling or bribing someone, just as a little child teases his mother to make a snowstorm or to stop the rain. Men soon learn, in certain very easy cases, that this explanation by someone's wish, by personal design, does not work. The successions of day and night, for instance, are easily seen to be regular, and to neither need nor heed the wishes of men or gods. The sun does not stand still at any one's caprice. Only a fool will hope to delay its setting by sacrifices or to hasten its rising by prayer. You may still beseech some person to speed to its mark the stone that you throw, but you would not expect him to hold suspended in air the stone you drop.

The progress of common knowledge first, and of the refined knowledge which we call science, later, gradually repudiated the caprices of persons—of gods, goddesses, fairies, and elves—as explanations of one physical event after another. The movements of the stars, the behavior

of all bodies in motion, the action of heat and light, the affinities of the chemical substances,—as fast as men learned enough, personal wants were forced to abdicate rule over each of these. Magic and begging were abandoned as means to control them. But every case was a struggle, and even the most thoughtful, the most scientific men were not converted to natural causation with all their hearts and minds. As a rule, even they kept all the superstitions they could. At a time when they would not have sung an incantation to make water boil quicker, they would have chanted formulas to make base metals change into gold. After they had ceased to pray someone that fire might leave wood unharmed, they would still pray that the wind might change.

By Darwin's time men of science had, of course, given up the cruder forms of belief in the regulation of nature by personal caprices; but they kept a refined form of it in the case of living matter. For they did not see any natural way by which the varieties of animal and plant life could have come into existence with all their adaptations to the world in which they existed. They had gradually become thorough naturalists in their astronomy, physics, chemistry, and, last of all, in their geology; but they did not see how to rely on nature alone in biology. They still reasoned, like primitive men or babies, that animals and plants were as they were because someone had chosen that they should be so. They could not find within nature any cause for the specific forms which living matter wore. Men of science before Darwin, his grandfather among them, had proposed causes inherent in the natures and surroundings of animals and plants themselves. But the forces they invoked were not adequate. So for species and adaptation science still accepted a cause outside of nature in the time-dishonored form of someone's personal wish.

Darwin showed a natural way. He found within nature forces able to have produced species and their adaptations. The wish for birds with the feathers of which men may keep

themselves warm or dry was shown to be as unnecessary to explain the birds' existence as the wish for water is to explain the combination of oxygen and hydrogen, or the wish of the gods to play marbles is to explain the spheroidal form of the earth and moon.

And Darwin's work did not suffer the caprice of persons to be considered a cause of mental events, of human psychology, of the history of men and nations. These also are to be understood, not by divining the intentions which they might possibly serve, but by examining them and the natural world of which they are a part. These, also, are to be controlled, not by devices to change someone's intentions, but by straightforward work with nature itself. Science and true religion now teach man to be throughout, in psychology as in physics, honest with nature and with himself. No excuse is left for hoping and fearing instead of thinking—for teasing and bribing instead of working. Our intellects and characters are no more subjects for magic, crude or refined, than the ebb and flow of the tides or the sequence of day and night.

Thus, at last, man may become ruler of himself as well as of the rest of nature. For, strange as it may sound, man is free only in a world whose every event he can understand and foresee. Only so can he guide it. We are captains of our own souls only in so far as they act in perfect law so that we can understand and foresee every response which we will make to every situation. Only so can we control our own selves. It is only because our intellects and morals—the mind and the spirit of man—are a part of nature, that we can be in any significant sense responsible for them, proud of their progress, or trustful of their future.

I have tried to make clear Darwin's direct contribution to the body of knowledge about human nature which we call psychology. This included a proof that the instincts and intelligence of animals and men are subject to variation and natural selection; a body of facts concerning human

likes and dislikes and their evolution; an account of the expression of the emotions which is after nearly forty years unequalled; and one of the first studies of the mental development of man during infancy.

I have tried to show also that indirectly, through the revolution he brought about in biology, he made, or helped to make psychology genetic, comparative, and concrete. He brought men of science to see that intellect and character grow, that their present nature is a result of their whole past history. He taught men of science to study the concrete individual differences which are of so great significance not only to the course of mental evolution, but also to the practical conduct of life.

To all human thinking and conduct Darwin taught two great principles. The first is the principle of evolution, of continuity,—that each succeeding segment of the stream of life, each successive act in the world drama, is the outcome of all that have gone before and the cause of all that are to come. The second is the principle of naturalism,—that in life and in mind the same cause will always produce the same effect, that the bodies and minds of men are a part of nature, that their history is as natural as the history of the stars, their behavior as natural as the behavior of an atom of hydrogen. If there were time I could show how this same contribution has acted to transform our views of all human institutions, of the state, the church, education, and every feature of civilization, and our treatment of every practical concern of life.

Gladstone and Lincoln lived in the thick of human business, and devoted their exceptional talents to the affairs of state. Each led a great nation, one through a generation of steady development, the other through the nation's greatest crisis. Darwin, making experiments in his quiet garden at Down, seems utterly remote from such leadership of men. Yet so far as such subtle problems can be calculated, we must conclude that Darwin will in the end have had the greatest influence upon social institutions, even upon government

itself. For, in the long run, the only cure for national ills and the only foundation for progress is science, sure and verifiable knowledge, directing a good will toward men. And this good-will itself can be aroused and increased only by use of the facts and laws of science. Even now, in the treatment of subject races, in legislation for criminals and dependents, in the care for public health, and in the new view of the family, we may see the influence of Darwinism beginning to spread to statesmanship and social control.

I venture to prophesy that when, a hundred years from now, men again celebrate the work of Darwin, there will be no more doubt of his transformation of the world's activities than of his transformation of its thinking. If the chief art of reason is life, so also the chief duty of life is science, the search for truth. The best citizen is the one who advances most the common good. The surest, perhaps the only sure, means of advance is increase in truth. To the search for the truth Darwin gave an intellect of wonderful fairness and care, and a life of perfect devotion.